

New Horizons Regional Education Center
1999 FIRST Robotics Competition

Summary of Research

1) Introduction

The New Horizons Regional Education Center (NHREC) in Hampton, VA sought and received NASA funding to support its participation in the 1999 FIRST Robotics competition. FIRST, Inc. (For Inspiration and Recognition of Science and Technology) is an organization which encourages the application of creative science, math, and computer science principles to solve real-world engineering problems. The FIRST competition is an international engineering contest featuring high school, government, and business partnerships.

2) Problem summary

Within the context of good sportsmanship, the competition encouraged New Horizons high school students to practice the engineering design and building process. Our students brainstormed, designed, constructed, and tested a 30 X 30 X 40 robot which in turn competed in regional and national events. Ten students and three instructors participated on the New Horizons FIRST team. Approximately eight currently employed and retired NASA Langley engineers assisted with the more technical aspects of the robot design. The students came from a variety of educational programs at New Horizons: Governor's school science students, career and technical students from such areas as welding and electronics, and also students attending the Point Option alternative education program. A few students from the 1998 team came back from college to assist us also.

New Horizons has an Peninsula-wide commitment to inspire the minds of our students to pursue technological careers. Getting students excited about learning and about how to apply their knowledge is one of our major goals along with providing potential good employees to local businesses. We recognize the need to provide training for both the college and the non-college bound student. This FIRST project is a great example of how these two student populations can learn and work together side-by-side on a team project, a valuable skill for future employment.

3.) Approach

In the early Fall of 1998, New Horizons personnel met with NASA engineers to create a time table of events to aid the team to meet its goal to have a fully operational robot completed by mid-February 1999. Next, during the mid-Fall into early winter, students worked on several projects including building a mobile platform and using a control system to operate their mobile platform. A mini-obstacle course was set up outside

ide to test the students driving of the platform. Also students and teachers alike cleaned up and arranged a construction room (about 45' X 15'). Workbenches and shelving materials were found and leftover parts from the 1998 FIRST kit were categorized and stored. On January 10, 1999 the official FIRST rules and a kit of robot parts were distributed to the students. Mid-January saw the team in intensive evening design/brainstorm sessions while teachers and mentors scoured the community to find some free carpet and other fabric materials for the playing field. The construction of the robot was completed on February 20, 1999. Compared to last year we had about 3 extra days to test our robot before placing it into our shipping crate, these extra days were welcomed by the control system group.

New Horizons attended three competitive events: a regional competition at NASA Kennedy Space Center 3/4/99 to 3/6/99, a regional competition at UTC New England in Hartford, CT 3/18/99 to 3/20/99, and the national competition, held at Epcot Center in Orlando, Florida during 4/22/99 to 4/24/99.

4.) Results

The goals of this project were to allow students to work hand in hand with engineers to learn the engineering process, how to work as a team, to learn the importance of prototyping, and to discover that engineering and technician/fabrication work are exciting careers to consider.

About one-half of the 1999 students on our team had also participated in the 1998 FIRST competition so the 1999 team was not a "pure rookie" team. The returning students were able to guide the newcomers so that fewer design and fabrication mistakes were made. The returning students were much more comfortable discussing various design techniques with the engineers--there was more "spirit"/participation in the brainstorming discussions by the students. Also the returning students were much more comfortable with the fabrication machines such as the drill press and band saw. Hence, students were able to do more of the fabrication work by themselves with less oversight by the engineers. When a survey was taken of both students and engineers most agreed that students did about 40% of the work on the robot and the engineers did about 60%. This was an improvement over the previous year's (1998) rookie team in which the staff estimated that the students did only about 20% of the work at best.

Success was achieved along several different lines. On the media front, our team took 5th place (out of 210 teams) at the national event in Florida. The team received a visit from Dan Goldin, head administrator of NASA, and received favorable newspaper coverage at home both before and after our 5th place showing. Overall, the students and engineers built a robot that functioned as it was designed to. Students learned the valuable lesson that the lack of pre-competition testing of the robot led to mechanical failures (and playing/maneuvering difficulties) on the

e field. Students and teachers observed how the engineers troubleshooted problems right on the spot in very tight time frames at the competitive events. Attending two regional events, rather than one, really aided our team improving the robot before the national event. During the 2nd regional event in Hartford, the physics teacher observed how the engineers suddenly discovered that our robot had poor load distribution throughout the drive-train mechanism-the load was distributed in such a way that fuses kept blowing out. Fortunately, this problem was diagnosed correctly and fixed before our next event, which was the national competition.

Students from various classes learned to communicate with one another more effectively, both orally and by email. Some learned that they had to overcome normal personality conflicts for the good of the team. Other students learned that they needed to listen and heed the advice that the engineers offered. Some returning students came back from college to offer wise advice to the newcomers and to also help in troubleshooting and fabrication projects.

New Horizons staff observed that the engineers from our community really enjoyed working with our students. The retired engineers from our community relished the opportunity to practice their skills again. Students appreciated being delegated fabrication and construction responsibility after the engineers carefully (and patiently) explained their reasoning. The engineers had a collective wealth of knowledge to share and it was interesting to observe how they communicated their ideas with one another when it came to compromising on design ideas. It should be noted that not only did the engineers spend time on the project at school but also spent many hours at home on design and prototype construction. It was an honor to watch the engineers enthusiastically support this educational project with their time and great effort.

The physics teacher continues to change his regular curriculum in some selected topics (e.g. torque) as a result of this project. More robotics examples are used in classroom lectures and homework assignments. Also the teacher is more comfortable explaining the nuances of different types of nuts and bolts!

5.) Conclusion

The New Horizons Regional Education Center deemed this robotics project a great success in our second year of participation in FIRST. Many odds and ends lessons were learned by all and during August-September 1999 some team mentors and teachers brainstormed on how to improve this project for the future. Students and teachers alike came away from this project with an increased respect towards troubleshooting, design work, fabrication techniques, and engineering in general. This project enhanced cooperation between science and non-science oriented students and also fostered better understanding and cooperation between teachers in different subject fields. Teachers in particular were more excited about their jobs due to the unique and un-textbook-like nature of